

AN ENQUIRY
INTO
THE REMOTE CAUSE
OF
CHOLERA.

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PREFATORY NOTE.

AN accidental circumstance recently led me into a train of reasoning on the cause of Cholera ; and while in the course of prosecuting my enquiries, I have felt myself called on, by the extensive devastating effects of the disease in this country, to communicate the result of the investigation which I have hitherto made. These pages have in consequence been hastily thrown together.

I have been the more induced to this, as the practical preventives suggested are extremely simple, and, to a certain extent, are in accordance with those already acted on. I have not ventured to *assert* that the hypothesis which I have presented explains or gives the true cause. The anxious contests now going on in the Medical profession, (to which I have not the honour to belong,) in support of their respective theories as to the remote causes, and a consciousness

of my own incompetency to decide, have restrained me from venturing to offer my ideas as conclusive. I have preferred rather to tender them as mere suggestions for farther enquiry in a field hitherto, so far as I am aware, unexplored.

EDINBURGH,
21st *February*, 1832.

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NO one can have read the various Treatises and Reports on the subject of Cholera, without arriving at the conclusion, that the theories which have been suggested to explain the remote cause are by no means satisfactory. The authors have in general been too anxious to support their own particular views ; material facts have often (perhaps unintentionally) been kept in the background ; others have been prominently brought forward ; while others are assumed without any legitimate evidence. The enquiry has hitherto been almost exclusively undertaken by gentlemen of the medical profession ; and a very slight perusal of their works must convince any one, who is accustom-

ed to weigh evidence, that although they are perfectly able to give testimony as to the effects produced on the patient, they are not the best qualified to explain the causes of these effects. Judging from the works which I have read, some of the authors seem unacquainted with the principles by which truth, whether moral or physical, must be investigated; and, perhaps, from being unaccustomed to consider the bearings and effects of evidence, they are too apt to deduce false conclusions and to theorise on assumed facts. Inferences of the most important nature are thus often drawn from mere hearsay, while these inferences again are taken as facts, from which new conclusions are deduced. The consequences have been precisely those which might have been anticipated. The medical world is divided into parties—each maintaining most anxiously a particular theory, and the other as keenly contending for a different one, while both dispute the accuracy of the facts relied on by the other side.

It is not my intention to support any particular theory. My object is to make *suggestions for further enquiry*. But in doing so, I must of course state the grounds on which I rest, in order to induce this additional investigation to be made.

The theories which have hitherto been adopted are three-fold. The most numerous class of writers explains the phenomena of Cholera on the assumption of its being contagious; another class imputes the disease to atmospheric causes; and another to terrestrial. It is possible that one or other of their opinions

may be correct, but it is quite impossible that they should all be correct. I do not think that any of these theories are well founded; and while I do not pretend to say that the hypothesis which I have formed is true, yet it rests on such a basis as at least entitles it to a high degree of probability, and to be made the subject of farther investigation.

It has been justly observed, that “in questions of difficulty, or such as are thought so, where more satisfactory evidence cannot be had, or is not seen, if the result of the examination be that there appears upon the whole, any, the lowest, presumption on one side, and none on the other, or a greater presumption on one side, though in the lowest degree greater, this determines the question even in matters of speculation, and in matters of practice will lay us under an absolute and formal obligation in point of prudence and of interest to act upon that presumption or low probability, though it be so low as to leave the mind in very great doubt which is the truth.”*

Proceeding upon this principle, and conceiving that the suggestions which I am about to offer may afford explanations of the various phenomena connected with Cholera more satisfactory than the theories either of contagious, atmospheric, or terrestrial influences, and that practical consequences, simple, but of great importance, may flow from them, I have considered it as a duty to present them to the world,

* Butler's Analogy, Introduction, page 14.

leaving their fate to be decided by the result of future enquiry.

To an ordinary spectator, whose intellectual vision has not been obscured by the subtle distinctions and perplexing statements urged in support of the various theories, the first circumstance which is forced upon his attention, in witnessing a patient under Cholera, is the uniform and generally severe suffering in the region of the stomach. The violent vomiting and purging naturally lead the spectator to infer, that some deleterious or poisonous substance must, in some way or other, have been introduced into the stomach ; and in this he is confirmed by the patient, who tells him that he experiences intense burning pain in the stomach, and clamorously demands to have his thirst relieved.

The next circumstance which attracts his attention, is the spasmodic effects under which the patient is labouring. He is naturally led to conclude that this also must be produced by some deleterious agent affecting the nervous system, because, by that system, the muscular powers are regulated and governed. The patient appears to be suffering under the utmost degree of prostration of strength, while at the same time the convulsions or cramps produce a state of exertion, which is not merely distressing, but exceedingly inexplicable. His body is cold and clammy, and yet he complains of intense heat. The medical attendants state that the action of the heart and the circulation of the blood are almost suspended,

and he sees them making in vain every effort to restore the circulation by friction, bleeding, and hot applications. When he asks them to inform him what can be the cause of these effects, one of them will tell him that they are produced by contagion ; another that they are the result of atmospheric influences ; and another that they are produced by terrestrial causes : But if the spectator should request an explanation, either as to the specific mode in which contagion, or the atmosphere, or the ground, produce these phenomena, he will receive such a general and indefinite answer as will leave his mind entirely unsatisfied.*

The importance of this point, and the vagueness of these theories, led me to make farther enquiries ; and I was directed in the line of my investigation by con-

* Dr Becker attempts to define the mode in which contagion acts. He says, that it is “an effluvium from the human body ;” that some think it arises when the patient is convalescing, while others deny this proposition. He states, that “ its physical properties are far from being known ; there is no satisfactory proof of its proceeding either from the vomit, alvine evacuations, or sweat of the patients ; nor can it be with certainty ascribed to the air inhaled by them ; *perhaps* it is produced by a mere passive evaporation from the body, which passes into the surrounding atmosphere.” While he thus *assumes* the existence of such an effluvium in Cholera patients, and founds his whole reasoning on it, he states that the theory of its propagation during convalescence is unsupported ; he supposes that “ the Cholera effluvium is chiefly or exclusively generated during the last period of life, *or after death* ;” and yet he tells us that “ there does not seem to be any evidence of its production in *the dead body*.” —*Becker's Letters*, I. p. 32. Similar assumptions, and similar reasoning, equally unsatisfactory, will be found in regard to the theories of those who support atmospheric and terrestrial influences.

sidering that, as the effects seemed to result from some deleterious or poisonous agent introduced into the stomach, the phenomena might receive some explanation from Toxicology, or the doctrine of Poisons. This is a subject which is unfortunately yet immature, but enough is known to satisfy me that some explanation may be derived from this branch of science.

Professor Christison, in his able treatise on this subject, states that poisons operate in two modes; some by actually destroying, corroding, or irritating the organ with which they come in contact, “ while others neither corrode nor irritate, but make a peculiar impression on the sentient extremities of the *nerves*, unaccompanied by any visible change of structure.”* After mentioning experiments illustrative and confirmatory of this distinction, he observes, that “ these facts are important, because some physiologists have doubted whether there really exist any local impressions of a purely *nervous nature, unconnected with organic change*, and arising from the action of poisons. Yet the existence of impressions of the kind is necessary to the stability of the doctrine of the sympathetic operation of poisons; that is, of the transmission of their influence from organ to organ *along the nerves*. Nay, in the instance of very many poisons supposed to act in that manner, we must still farther believe in the existence of primary nervous impressions, which are not distinguishable by any local sign whatsoever.”†

* Christison on Poisons, p. 1.

† Ibid. p. 3.

In regard to this class of poisons he states, that while some of them produce local injury to the organ, others produce little or no such injury, and that their remote effects “ are those of *depressed action of the heart, great feebleness, fainting, imperceptible pulse, cold extremities*. Even the less prominent of the secondary symptoms are almost all referable to a *depressed state of the circulation*. In particular, they are *not* necessary, and indeed *are seldom actually blended with any material symptom of disorder in the brain*, which certainly could not be the case if the general or whole system suffered.”* In another passage he says, in regard to irritant poisons generally, that “ the stomach is the organ which suffers most invariably from the operation of the irritant poisons ; the symptoms referable to the operation of it are acute and generally *burning pain* ; sometimes lancinating or pricking pain, *sickness, vomiting*, tenderness on pressure, tension in the upper part of the belly, occasionally swelling.”† Again he mentions that “ the symptoms now briefly enumerated are accompanied in almost every instance with great *disturbance of the circulation, quick fever pulse, excessive prostration of strength, coldness and clammy moisture of the skin*.”‡

In one of the most satisfactory treatises on Cholera,§ an experiment made by Mr Brodie upon a dog, with a poison called the Upas Antiar, is mentioned, which produced effects on its constitution similar to those

* Christison on Poisons, p. 15. † Ibid, p. 85. ‡ Ibid, p. 86.

§ Bell on Cholera, 2d edit. p. 34.

which the Cholera does upon the human constitution. “Mr Brodie inoculated the thigh of a dog with the Upas Antiar—in twelve minutes the dog was languid—in fifteen minutes the heart was beating very irregularly, with frequent intermission, and there was a slight rigor—in twenty minutes the heart was beating feebly and irregularly; he was sick and vomiting, but the respirations were as full as under natural circumstances, and he was perfectly sensible. At the end of twenty minutes he suddenly fell on one side, and was apparently dead—the thorax was immediately opened; the heart had ceased contracting, and was distended with blood. There was one distinct full inspiration after the dissection commenced.”

This experiment proves that a poison has the effect to suspend the circulation of the blood, and that the consequence of this is sickness and vomiting, while the respiratory functions, and those of the sensorium remain entire. The same phenomena are displayed in a patient labouring under Cholera.

But while this experiment afforded evidence that *poisons* are capable of producing these effects, I was satisfied that unless I should be able to discover some agent possessed of locomotive powers, it would scarcely be possible to explain the phenomena attending the progress of Cholera. I was therefore led to enquire whether there were not *animal* poisons capable of producing similar effects, and in this I was not disappointed. Indeed within these few years a disease, which was traced to an animal poison, suddenly and

simultaneously appeared in different parts of Leith, the symptoms of which were almost identical with those of Cholera ; and there can be no doubt that it would have been supposed to have been the Indian Cholera, had it occurred at present, and had the cause which produced it not been discovered. A full report by Dr Combe, on this disease, (which displayed itself at Leith in June, 1828,) will be found in the twenty-ninth volume of the Edinburgh Medical and Surgical Journal, page 86. He states, that on the morning of the 21st, he was called to visit a poor man, whom he found labouring under symptoms which were quite new. He was almost immediately thereafter called to visit another patient. “ Medical men were seen in all directions hastening to afford relief in this sudden calamity. The town was in a ferment ; many deaths were reported, and hundreds of individuals were stated to be suffering under it. Matters, however, were not so deplorable ; but about thirty cases occurred, with *great uniformity of symptoms*, but *varying very much in severity*.” — “ They were entirely confined to the lowest ranks of life, and some of the hovels which we visited presented a sad spectacle of want and filth. The weak and aged *suffered most*, but *no age*, from two to seventy, *was exempt* from its effects.” He then describes the symptoms thus :—“ The action of the heart *was feeble*, the breathing *unaffected*, the face *pale*, expressive of much anxiety, the surface *rather cold*, and the mental faculties *unimpaired*.” There was *great debility*, *nausea and vomiting*, prickly feeling of the hands, “ slight pain in the abdomen, increased on

pressure, particularly in the region of the bladder, which suffered variously in its functions. *In some, the secretion of urine was suspended*, in others it was free, but passed with pain and great effort." In one of the cases "there was a universal trembling, accompanied by a *fixed clenching of the hands*. *He spoke rationally till the last, and died as if by increasing weakness.*" In another "of the patients, the gastric symptoms were from the first very severe, attended with *vomiting and spasm of the stomach and limbs*. In a few days this was followed by peritonitis requiring the repeated use of the lancet."

From the alarm and agitation of the people, combined with the aversion to dissection, Dr Combe states, that he found it impossible, although under the protection of a warrant from the Magistrates, to make any satisfactory examination into the *post mortem* appearances. He says, however, that the stomach presented, neither in its outer nor its inner surface, any decided morbid change, nor could any effect of this nature be discovered in any of the viscera; that there was great emaciation, and in the smaller intestines, and in the course of the ileum, patches of a dark red colour.

There can be little doubt that if *the cause* had not been discovered, and the people put on their guard, the disease would have extended, and the conclusion would have been drawn that the Indian Cholera was raging in Leith. One of the patients, however, accidentally mentioned that he had on the preceding evening supped on mussels, and on investigation it

was found that all of those who were suffering had partaken more or less of this species of food. It also produced similar effects on some of the lower animals, a circumstance which I mention, because this also occurs in Cholera. An idea was at one time entertained that those effects had not been produced by the animal itself, but by copper, with which it was supposed to have been impregnated ; but both Dr Combe and Professor Christison concur in stating that this notion is entirely unfounded. Indeed the latter mentions various other cases, attended with precisely similar symptoms, produced by fish poison in different parts of the world, and that although the knowledge of poisons of this class is extremely limited, yet it is clearly ascertained that various animals, which inhabit or frequent *waters*, are of the most deadly poisonous nature. The mode of action of these animal poisons is remote—operating upon the *nervous system*, suspending the circulation of the blood, causing vomiting, purging, spasmodic affections, and suspension of the urinary functions, while the intellectual faculties remain entire.

Let us now contrast these facts with those which appear from the writings of medical men uniformly to attend Cholera. On this there is very little diversity of statement among them. The primary symptom is indicated by the countenance, which assumes an appearance of deep marked anxiety ; the next is vomiting and purging ; then great prostration of strength ; intense burning pain in the stomach ; the skin cold and clammy,—violent and excruciating

spasms—stagnation of the sanguiferous system, and suspension of the urinary secretion. A marked peculiarity is, that although the body is almost lifeless, yet *the intellectual faculties remain entire*. The attack on various patients is sudden and simultaneous, and the symptoms in each exactly the same, but different in degree.

Thus, although in some minor respects there may be differences between the appearances presented by the Cholera patients, and those who suffered under the influence of the poison in Leith; yet in all the great leading particulars they are identically the same. It may also be observed, that the *remedies* which were found productive of beneficial effects in the Leith cases, were *precisely the same* as those which are found most available in the treatment of Cholera. Dr Combe says, that “with respect to the practice adopted, it was uniform, and attended with evident good effects. In some the stomach was emptied by an emetic; in others, brisk laxatives were administered, followed by *stimuli, such as spirits, ammonia, and nitrous ether, and venesection*.” So in Cholera the remedies which have been suggested have been evacuants of the stomach, strong *stimulants*, accompanied with bleeding and friction.

We have thus seen that there is a class of poisons which acts remotely—attacking the *nervous* system, and producing suspension of the circulation of the blood, vomiting, purging, spasms, &c. while the mental faculties remain entire—and that animal poisons belong to this class.

Now, let us attend to what is the more immediate cause of Cholera. Mr Bell states that it appears to him to be embraced in these propositions.—“1st, The great ganglionic, or sympathetic *system of nerves*, is possessed of a power wholly *unconnected with cerebral influence*, which it may retain after the brain and spinal marrow are removed, and which may cease to exist while these retain the full exercise of their functions. 2d, To this system belongs the *circulation and distribution of the blood*; and it consequently has a most important share in regulating *secretion, and in carrying on the involuntary functions*; and, 3d, To the *suspension of this power of the system*, is, I conceive, to be ascribed the disease which has obtained the name of Cholera Asphyxia. These conclusions are the result of an intimate practical acquaintance with this disease, and an anxious study of all its phenomena, and they are supported by a careful and minute enquiry into the nervous system in all its bearings.” *

While the doctrine of poisons might tend to throw some light on the subject, by showing, 1st, that one class of poisons acts directly on the *nervous system*, and suspends the *circulation of the blood*; 2d, that these effects may be produced by an *animal of a poisonous nature*; and, 3d, that this animal is one which inhabits *waters*; there still remained a difficulty which required to be removed.

* Bell on Cholera, 2d edit. p. 30.

It was clear, that although an important step had been made in the enquiry, still it might be asked, how does it happen that the disease has travelled so steadily and regularly over Asia and Europe, carrying devastation in all its progress? To meet this difficulty, it was necessary to suppose that such an agent as I have pointed at, possessed great facility in the exercise of locomotive powers; and it was impossible that it could be similar in nature to the mussel, which is exclusively an aquatic animal.

It occurred to me, that to aid the investigation it was necessary to have recourse to the light which might be obtained from another science—that of Entomology. And here, while various facts were afforded capable of explaining many of the phenomena which hitherto have remained in obscurity as to the cause of Cholera, difficulties occurred, from the science being still little cultivated. Indeed, in one of the ablest works on the subject, it is stated, that “one principal cause of the little attention paid to entomology in this country, has doubtless been the ridicule so often thrown upon the science;” and an apology is made for venturing to obtrude it on the attention of the public.* And it has also been correctly observed, that “our ignorance of their nature and habits arises not only by reason of the minuteness of their parts, (for that minuteness we can in some measure follow with glasses,) but also by reason of the remoteness of their manners and modes of life from those of larger animals.”† The

* Kirby and Spence on Entomology, vol. i. Preface.

† Paley's Natural Theology, c. xix.

information, however, derived from this science is at least sufficient to raise so strong a *probability* that the true cause of Cholera may be traced to an insect, possessing either in itself, or in its eggs, or larvæ, poisonous qualities, that it affords grounds to suggest that attention should be directed to this as a proper subject of further enquiry. On the supposition that there is an animal of such a nature in existence—a supposition which is not only perfectly possible, but which the various circumstances render highly probable—almost all those phenomena which have been considered inexplicable, may be explained, and many of those facts which are involved in obscurity and contradiction, may be, by farther investigation, cleared up.

With reference to the present subject, the first and prominent circumstance connected with insects, worthy of attention, is the destructive effects which they produce both on animal and vegetable *life*. As to this, it has been well and eloquently observed, that “insects may be said, without hyperbole, to have established a kind of universal empire over the earth and its inhabitants. This is principally conspicuous in the injuries which they occasion, for nothing in nature that possesses or has possessed animal or vegetable life is safe from their inroads. Neither the cunning of the fox, nor the swiftness of the horse or deer, nor the strength of the buffalo, nor the ferocity of the lion or tyger, nor the armour of the rhinoceros, nor the gigantic bulk or sagacity of the elephant, nor even the authority of

imperial man, who boasts himself to be the lord of all, can secure them from becoming a prey to these despised beings. The air affords no protection to the birds, nor the water to the fish. Insects pursue them all to their most secret conclaves and strongest citadels, and compel them to submit to their sway. Flora's empire is still more exposed to their cruel domination and ravages, and there is scarcely one of her innumerable subjects, from the oak, the glory of the forest, to the most minute lichen that grows upon its trunk, that is not destined to be the food of these next to non-entities in our estimation."*

Examples without number of their destructive effects, both on animal and vegetable life, are to be found in the work referred to, and the alarms which are created in consequence of our ignorance of the true cause of the ravages produced by them, and the means of protection, are forcibly pointed out. Of this an apposite illustration is afforded by what occurred in 1788, in relation to the threatened visitation of a destructive disease in wheat, which was known to prevail in North America. "The privy council sat day after day, anxiously debating what measures should be adopted to ward off the danger of a calamity more to be dreaded, as they well knew, than the plague or pestilence. Expresses were sent off in all directions to the officers of the customs at the different outports respecting the examination of cargoes—dispatches written to the

* Kirby and Spence, vol. i. p. 86.

ambassadors in France, Austria, Prussia, and America, to gain that information of the want of which they were now so sensible ; and so important was the business deemed, that the minutes of council and the documents collected from all quarters, fill upwards of 200 octavo pages. Fortunately England contained one illustrious naturalist, the most authentic source of information on all subjects which connect natural history with agriculture and the arts, to whom the privy council had the wisdom to apply, and it was by Sir Joseph Banks' entomological knowledge, and through his suggestions, that they were at length enabled to form some kind of judgment on the subject.* The cause of this alarm was an insect called the Hessian fly ; but although its devastations in America had been unparalleled, the information which could be procured as to its nature was unsatisfactory.

On *animal* life equally with the vegetable, the destructive powers of insects have been strikingly manifested. "A worse pest" (the same authors say) "than any hitherto enumerated is a *minute fly*, concerning the genus of which there is some doubt. In Servia and the Bannat it attacks the cattle in infinite numbers, penetrates their generative organs, and by its poisonous bite destroys them in the space of four or five hours."† Another insect compels the inhabitants to desert their native districts. "The appearance, nay, the very sound of it, occasions more trepidation, move-

* 1 Kirby and Spence, 52.

† Ibid. p. 151, 152.

ments, and disorder, both in the human and brute creation, than whole herds of the most ferocious wild beasts, in tenfold greater numbers than they, ever would produce. As soon as this plague appears, and their buzzing is heard, all the cattle forsake their food, and run wildly about the plain, till they die worn out with fatigue, fright, and hunger. No remedy remains for the residents on such spots but to leave the black earth and hasten down to the sands of Albara, and there they remain while the rains last. All the inhabitants of the sea-coast of Melinda down to Cape Gardafan, to Seba and the south of the Red Sea, are obliged, in the beginning of the rainy season, to remove to the wet sand, to prevent all their stock of cattle from being destroyed.”*

From the attacks of insects human beings are no more exempt than the lower animals. Many of the diseases of the skin are traced to insects as their causes. They even gain admission into the stomach, by means which in many cases are inexplicable, and in others have been discovered merely by accident. “People in general,” say the authors already referred to, “seem not aware that beetles make their way into the human stomach. Yet there is abundant evidence, which proves beyond controversy, that the meal-worm, although its usual food is flour, has often been voided both by male and female patients, and in one instance is stated to have occasioned death. How these grubs get into the stomach it is difficult to say.

* 1 Kirby and Spence, p. 152.

Perhaps the eggs may have been swallowed in some preparation of flour.”* The dysentery, or diarrhoea, has also been found to have been occasioned by the introduction of insects into the stomach. Rolander, a student in entomology, while residing in the house of Linneus, had been frequently attacked with this complaint, while the rest of the family were free from it. He was advised by Linneus to examine his fœces, in which he discovered innumerable animalcules. “It was next a question how he alone came to be singled out by them; and thus he accounts for it. It was his habit not to drink at his meals; but in the night growing thirsty, he often *sipped some liquid* out of a vessel made of juniper wood. Inspecting this very narrowly, he observed in the chinks between the ribs a white line, which when viewed under a lens, he found to consist of innumerable ascari, precisely the same with those he had voided. Various experiments were tried with them, and a preparation of rhubarb was found to destroy them most effectually.”†

The next remarkable circumstance in the history of insects, and more especially of those of a destructive nature, with reference to the present enquiry, is, that while they spread over extensive districts, they preserve one *great line of direction*. Of this an illustration is afforded by the Hessian fly, already alluded to. “It first showed itself in Long Island, from whence it proceeded inland at about the

* 1 Kirby and Spence, vol. i. p. 134.

† Ibid. p. 94.

rate of fifteen or twenty miles annually ; and by the year 1789, had reached 200 miles from its original station. Though these insect herds traverse such a tract of country in the course of the year, their flights are not more than five or six feet at a time. Nothing interrupts them in their destructive career, neither mountains nor the broadest rivers.” * In Grenada, an insect of the nature of the ant appeared in such infinite hosts, and were so destructive, that a reward of L.20,000 was offered to any one who should discover an effectual mode of destroying them. “ Streams of water opposed only a temporary obstacle to their progress ; even the all-devouring element of fire was tried in vain. When lighted to arrest their route, they rushed into the blaze in such myriads of millions as to extinguish it.” † Their progress was only arrested by a dreadful hurricane, which produced devastation among several of the West Indian Islands. It is also well known, that locusts, while they spread themselves out like a great army, travel in a particular direction. In 1748, Europe was visited by an immense swarm, which came from the East. There is some dispute as to the particular line which they usually follow ; but it seems to be agreed, that when they do adopt a particular course, they continue to follow it. Hasselquist has observed, that “ they migrate in a *direct meridian line from south to north*, passing from the deserts of Arabia, which is the great cradle of them, to Palestine, Syria,

* Kirby and Spence, vol. i. p. 169.

† Ibid. pp. 182, 183.

Carmania, Natonia, Bythinia, Constantinople, Poland, &c. They never turn either to the east or to the west; but this (say the above authors) must be a mistaken notion, for those which Major Moor saw at Poonah must have come *due east*. Mr Jackson also noticed their course north of the line; and Sparman tells us, that those south of the line migrate *in the same direction*.* Those which visited Europe in 1748, appear to have followed very much the same line as that along which the Cholera has travelled. They came through Wallachia, Moldavia, Transylvania, Hungary, and Poland. In Transylvania an attempt was made to arrest their progress by discharging pieces of artillery loaded with small shot at them, but although numbers of the enemy were destroyed, the mighty and dense army went on undisturbed in its progress.† In answer to a question, “Could they not, by fright, or some other method, be *turned from their dreadful course*, to steer for some river, and by that means be obliged to destroy themselves?” Kirby says, “that all such experiments would be about as effectual, as sending an army, with all the apparatus of war, to take the field against them, as is said to be done in Asia.”‡

In reference to another class of insects, the same author observes, that “they resolutely pursue a *straight course*, and neither buildings nor rivers, even though myriads perish in the attempt, *can divert them from it*.”

* Page 221.

† Shaw's Zoology, p. 129.

‡ 1 Kirby and Spence, p. 221.

Those which have been alluded to, are, from their size, brought immediately under our observation, but the varieties and the minuteness of insects are infinitely beyond all calculation. There is, indeed, much reason to believe, that immense numbers exist, of the properties and habits of which we are entirely ignorant. A recent writer says, that “ of Entomology there are no bounds to the stores, and it may be truly said of insects,—*Sed neque quam multæ species nec nomina quæ sint, est numerus.*”^{*} And Kirby and Spence remark, that it may be safely assumed, that “ at least three-fourths of the existing species remain undiscovered,”[†] while those in eastern countries are in a great measure unknown.

Their fecundity, and the swarms which are generated, and which yet escape common observation, are beyond comprehension. “ The multiplication (say the authors so often alluded to) of these little creatures is infinite, and almost incredible. Reaumur has proved that in five generations one aphid may be the progenitor of 5,904,900,000 descendants, and it is supposed that in one year there may be twenty generations. This astonishing fecundity exceeds that of any known animal, and we cannot wonder that a creature so prolific should be proportionally injurious. Some species, however, seem more so than others.”[‡] Indeed, the swarms of locusts have been so great as to intercept the solar light, so that when they flew low, one

^{*} MacLeay's *Horæ Entomologicæ*, Preface, page 6.

[†] Kirby and Spence, vol. iv. p. 481.

[‡] Kirby and Spence, vol. i. p. 174. 6 Shaw's *Zoology*, 168.

person could not see another at the distance of twenty paces ; and it is mentioned, that “ in the southern parts of Africa, an area of nearly 2000 square miles might be said literally to be covered by them.”*

Many of the known classes of insects are in their habits both aquatic, aerial, and terrestrial ; and many of them, while they attach themselves to rivers, are capable of existing upon land, and, of course, capable of transporting themselves with facility from place to place. “ The waters (say Kirby and Spence) you will find nearly as prolific in insects as the land. Many frequent humid places, as the banks of rivers and ponds.” Some, which they describe as “ pests, do not frequent those rivers called by the natives of South America ‘ black waters’, but only those which they name ‘ white waters.’ ” †

Stagnant waters are more productive than running ones ; and while they mention that they do not recollect of finding any insect in waters absolutely salt, still particular species frequent brackish waters. “ The vicinity and borders of woods also generally abound in insects of every order.” ‡

Another peculiarity in the history of insects, and one which may afford light as to the cause of Cholera, is, that many insects deposit their eggs in water, where the larvæ are generated, and continue there till they come into the insect state. Shaw states, that “ the majority of insects are observed to be annual, finishing the whole term of their lives in the space of a

* Kirby and Spence, vol. i. p. 214, 215.

† Vol. iv. p. 500, 501.

‡ Vol. iv. p. 500.

year or less, and many do not survive half that time ; nay, there are some who do not survive many hours ; but this latter period is to be understood only of the animals when in their complete or ultimate form, for the larvæ of such as are of this short duration, have in reality lived a very long time *under water*, of which they are natives ; and it is observed that water insects in general are of longer duration than land insects.”* Among the insects of this description, are many belonging to the order Neureptera, (to which locusts belong,) while some of those of the order Diptera, such as gnats, display the same nature.†

Some classes also are adapted to live in all sorts of climates, both within the torrid zone and in the arctic circle. “ We find (says MacLeay) that insects such as gnats, mosquitoes, &c., which pass their larvæ state *in water*, thus avoiding extreme cold, and whose existence in their perfect state being naturally ephemeral, must therefore suffer little from the shortness of the summer, are nowhere more troublesome than in the very coldest climates.”‡ In like manner, Kirby and Spence state, “ that one would at first imagine that regions where the polar winter extends its icy reign would not be much annoyed by insects ; but however probable the supposition, it is the reverse of fact, for nowhere are gnats more numerous. These animals, as well as the tipulidæ, seem endued with the privilege of resisting any degree of cold and any degree of heat.”

* 6 Shaw's Zoology, 14.

† 6 Shaw, 249—379.

‡ Hor. Ent. page 46

Now, on the assumption that the hypothesis which I have suggested is correct—that Cholera may be produced by an animal poison—the facts which I have stated in relation to insects, show the possibility that *they* may be the agents by which the recent dreadful destruction of the human race has been accomplished. We have seen that their devastating effects, both on animal and vegetable life, are incalculable; that while they spread themselves like a mighty army over extensive districts, they follow one grand line of direction; that many of those which are known attach themselves to rivers and waters, depositing their eggs where the larvæ are generated; that their numbers and variety are infinite; and that many of those with which we are acquainted are capable of existing in the extremes of heat and cold.

Let us now compare these ascertained entomological facts with the phenomena presented by the history of Cholera.

Of the extensive destructive effects of this pestilence, the records of the human race since 1817, present memorials too well known to require detail here. The great and leading peculiarities of it, however, are these—1st, That, with certain unexplained and slight exceptions, it has steadily and progressively travelled from the banks of the Brahmaputre and the mouth of the Ganges along *a north-west* line, stretching its wings to the north and south. 2dly, That it has shown a marked predilection for rivers, more especially those which either ascend or descend in the same line of direction; and also for all other waters,

such as inland lakes, pools, open wells, &c. 3d, That its fatal effects have originated, and been displayed, among those residing either on, or in the immediate vicinity of the banks of waters; that it frequents, and is most destructive in places peculiarly adapted to the nourishment of insects, such as low, damp, filthy houses, or other places of abode, while in dry, elevated, cleanly positions, its ravages are either unknown or comparatively unimportant; 4th, That, (although the enquiry has been very limited,) those who have either been in situations in which they may naturally be supposed to have taken liquids or food to which the insect may have had access, or in which it may have deposited its eggs, spawn, or larvæ, or who, it appears, have actually taken food of this description, have been chiefly attacked; and, 5th, That its attacks are sudden and simultaneous in different places at one and the same time—breaks out without any previous apparent cause—rages for a time, and then, in the most unaccountable manner, disappears, and shows itself in another quarter, where it goes through the same progress.

1. On referring to a map of the world, and drawing a line from Calcutta in a north-west direction, it will be found to pass through all those countries which have been affected by the pestilence. It traverses the northern part of Hindostan, the centre of Persia, the countries to the west, passing through Hungary and Germany, and at last terminating in the British Isles. While such appears to have been the grand route, the

wings extend themselves both to the north and to the south. These, however, also advance to the north-west. It likewise appears, from maps which have been made of its progress, that while in its outset it was broken and dispersed, it soon assumed a formed shape, marching over large districts of country, and displaying itself at remote points at one and the same^z time.* Whether this be strictly correct or not, I am not prepared to say ; but the fact admits of no doubt that, taking its progress upon the great scale, the line of march was almost due north-west till it reached the Persian Gulf, where the northern wing appears to have begun to stretch itself more to the north. As the great Arabian Desert is situated to the south of that Gulf, it is possible, either that we may have no information in regard to what occurred there, or it may be that it left that arid district, and followed that element to which it seems peculiarly attached.†

2. The fact that it has travelled along the course

* Bell on Cholera, p. 72.

† It has been said that it appeared in China, and also in the Mauritius ; and in regard to this there can be no doubt. The information, however, as to its progress in these countries is exceedingly defective ; and it may possibly hereafter appear that the origin of the disease may be traced to China : if so, then the line, although carried more to the south, would, from the point of the origin of the disease, remain as formerly. At present we can only proceed on those facts which are clearly ascertained, and it is impossible for any one who is in the slightest degree acquainted with its course, to dispute that it has been in the direction already mentioned.

of rivers, is one on which all the medical writers concur. The only difference which exists among them is, whether it be not confined exclusively to rivers which are navigable. Those who support contagion, maintain very anxiously that it travels along those only which are navigable, and they endeavour to explain the transmission of it to waters not navigable, by *inferring* that it *must* have been carried along the high-roads. The opponents of this theory, on the other hand, state the fact to be different, and they are the more entitled to credit, that the circumstance of the disease being connected with water or not, does not go in any respect to support *their* theory.

The important fact, however, with reference to the present enquiry, is, that it has travelled along rivers. It is said first to have displayed itself on the Brahmaputre, then to have proceeded along the banks of the Hoogly, the Ganges, and the Jumna; to have visited almost every river in Hindostan; to have crossed to the Persian Gulf, and there, on each bank, to have attached itself to the rivers; then to have embarked on the Tigris and the Euphrates till it reached the Don and the Wolga, along which it continued its progress, stretching through the various branches flowing from these great trunks, till it passed to the Dwina, whence it extended itself to the north and the south, along the Neva and the Warthe to the Oder and the Elbe, and ultimately into the British Isles, where it has hitherto appeared on rivers or streams.

It is quite true that those who support the doctrine of contagion may *infer*, that these being navi-

gable rivers, the disease may be carried by contagion ; and as it is not my intention to enter into this discussion, I shall only observe, that the fact of its following the line of rivers, also affords evidence in support of the suggestion which I have ventured to make. If, however, credit is to be given to other authors (whose veracity is unimpeachable), it is *not* true that the disease is confined to navigable rivers, nor transported along roads. Mr Bell says, “ that much stress has been laid by writers on this subject, on the fact that Cholera has travelled along the banks of rivers. *Undoubtedly it has done so ;* but in so far as regards India, the writers who rely so confidently on this fact, have not adverted to the peculiarity that the progress of the disease along the banks of rivers has *not* been confined, as they seem to suppose, to navigable rivers. It has extended itself along the banks of rivers, whether navigable *or not.*” * In support of this, a more remarkable fact could not be stated than that which appears from the Bengal Report. “ On the morning of the 11th of May 1818, a detachment of ninety men of the 1st battalion 26th Native Infantry marched from an inferior post to join the main body of troops encamped at Sangore. After an ordinary march, it halted in *perfect health* half way, under shelter of *a few trees on the banks of a small lake*, situated in the midst of an open space, about three miles in circuit, and surrounded by *low woody hills*. The whole remained

* Bell on Cholera, p. 84.

well until the fall of night, when Cholera broke out amongst them. The first man was taken ill at midnight, and died in half an hour. Several others fell sick within the next few hours, and before sunrise twenty out of the ninety were overtaken by the disease.”* This is quite inexplicable on the theory of contagion, and still more so, as it is stated that the *sick* were carried forward to the encampment of a larger body of men who were in perfect health, and that these men were not thereby affected. But this apparent anomaly is capable of a satisfactory explanation, on the supposition of the existence of a poison impregnating or existing in water ; for as it may safely be inferred that the men, on their arrival on the banks of the lake, after a fatiguing march in a hot climate, would avail themselves of the water of the lake, the poison would be introduced into the stomach, and the effects produced which a similar cause gave rise to in Leith.

Neither does it appear to be true, that the disease travels along high-roads ; and indeed, while the various writers repeatedly mention its progress along the banks of rivers, they allude only incidentally to highways. Mr Bell says, that “ I am aware it has been supposed that the disease adhered to thoroughfares, and was only found in great cities. In answer to this, I may refer to the reports of the Indian Boards, which conclusively negative that supposition ;” and he asks, “ under correction of every man

* Bengal Report, p. 132, 133.

who has been in India, whether it has not again and again happened, that parties of officers and their servants have been fatally attacked with Cholera on hunting excursions in the interior of the country?"* And we have seen it running up the little rivers or streams of Scotland, in preference to passing along the high-roads. There can be no doubt, however, that it must occasionally appear on public roads; but this is not in the slightest degree inconsistent with the possibility, or even the probability, of the poisonous agent operating upon travellers, through the medium of water taken from open wells, or otherwise. As to roads, the facts, however, are extremely meagre, and it would be desirable that farther information could be obtained.

3. The most distinguishing peculiarity in the history of this disease is, that it originated under circumstances and in a position *eminently favourable to the generation of insects*; and that it has uniformly displayed itself in situations adapted to their propagation, or to the deposition of their eggs, and generation of their larvæ, such as the banks of rivers, lakes, swamps, and low damp filthy places.

There is some dispute as to whether it first appeared at Mymensing, on the banks of the Brahmaputre, or at Jessore, situated in the Gangetic Delta. To the present enquiry this is of little importance, because there is little or no difference in the nature and character of these respective localities. They are both traversed by rivers, and interspersed with waters, woods,

* Bell, p. 84.

and jungles. On turning to the map, this will be perfectly evident, and it accords with the descriptions which have been given.

The years 1815, 1816, and 1817, were remarkably hot and humid. The Hot season in India commences with the approach of March, and the heat gradually increases till the latter end of May, when the weather becomes exceedingly sultry and oppressive. The Rainy season sets in about the middle of June, and in the third month the Ganges attains its highest point of elevation. “By this time the low country is inundated throughout, and in the rice-fields the ears of the grain may be seen floating on the surface of the deluge. The habitations of the peasantry, built on artificial mounds, are raised beyond the common ascent of the waters.”* The same author mentions, that “during the rainy season of 1815, the fall of rain was excessive, and what rendered it the more remarkable was, that the Ganges, the Soane, and Coossee rivers burst their boundaries, and destroyed much agricultural property in the neighbouring districts.” “On the other hand, the hot season of 1816 was distinguished for drought and intense heat.”† After mentioning that this became so intense that the rivers were dried up, he says, that “the 1st of September ushered in a most unexpected change. The unwonted drought suddenly yielded to a deluge of rain, which continued unabated through the month, and gave rise to a deeper

* Kennedy, page 9.

† Page 14.

and more extensive inundation than had happened at any period within the recollection of the oldest inhabitant.”* “The year 1817 was marked with as singular deviations from the ordinary course of the seasons as those of the preceding year.”† “In Jessore, Backergunge, Nuddeea, and every other part of the Gangetic Delta, the descent of heavy rain had been long and uninterrupted, and nearly the whole country, especially in the lower division of the province, was one sheet of water before the middle of August. Lakes and tanks, that in former seasons had remained nearly dry for a considerable time, were now filled to overflowing, and remained so for a comparatively long period. The measure of the rain that had descended was estimated at 120 inches, which is more by one-third than the common quantity in Bengal.”‡

It was under these circumstances that the disease first broke out with the utmost virulence. It had been previously known in India, but it now assumed a violence and extent altogether unprecedented.

It began some time between the month of March and May 1817, being towards the end of the *hot* season and the commencement of the *rainy*. Attention was particularly directed to Jessore, where its ravages were dreadful; and one of its peculiarities was remarked, that while the symptoms were *uniform* in all the patients, the attacks were *simul-*

* Kennedy, p. 15.

† Page 16.

‡ Page 18.

taneous among immense numbers. “Jessore,” says Mr Kennedy, “is a crowded, dirty, ill-ventilated place, surrounded by a thick jungle, and exposed during the rains to the effluvia of an immense quantity of stagnant water. The district of which it is the capital in its southern quarter, is composed of the ‘Sunderbunds,’ a name given to numerous low marshy islands contained in the Delta of the Ganges, and formed by the different channels through which that river travels to the ocean. The Sunderbunds are overgrown with wood, and inhabited only by tigers, reptiles, and such other denizens of the wilderness.” “So unforeseen,” says he, “and unparalleled was the attack, that the functionaries, in extreme consternation, closed the civil courts of the district, and business of every description was abandoned for a time. In the short space of a few weeks 10,000 of the inhabitants perished in the single district of Jessore.”*

After committing the most destructive ravages in this natural hot-bed and nursery of insects, and doing so in the most erratic and apparently uncertain direction, it appears very soon to have formed itself into an extended line, stretching gradually to the north and to the south, and advancing towards the north-west. It visited Calcutta early in September, and devastated that part of the town peculiarly adapted for the reception of insects and the generation of their larvæ. “The native town is chiefly composed of mi-

* Kennedy, page 20.

serable lanes, narrow, dirty, and unpaved ; and the majority of the dwellings are low huts, with side-walls built of mud, mats, and bamboos, and covered with small tiles. Amongst the swarming population of these filthy receptacles, in which all descriptions of disgusting animal and vegetable odours abound, the distemper went along a wide career of destruction." " The inhabitants, exhausted by the heat and fatigue, and confined during the night with their families, often six or eight in number, in a small space, to which fresh air was a stranger, were attacked by Cholera in hundreds, and a frightful proportion of those attacked were swept away in the lapse of a few hours." " It was peculiarly destructive in the adjacent villages, which are made up of mud or straw huts, are individually from six to twelve feet square, and so huddled together, that there is scarcely room to pass between. In each of these unhealthy habitations a whole family resides, and not unfrequently cows and other domestic animals are added to the proper inmates. These dependencies, moreover, are everywhere intersected by pools, broad ditches, and channels, which, in the rainy season, become the reservoirs of foul water and corrupt weeds."*

Extending its ravages, but adhering to the banks and channels of rivers, it attacked " the cities of Dacca and Patna, the towns of Balasore, Burishole, Burdiwan, Rungpore, and Malda. Along all the

* Kennedy, pages 23 and 24.

tracks of rivers, the mass of the population was sensibly diminished by the pestilence."

In the limited space within which I must at present confine myself, it is impossible to enter on a detailed description of the various places which it assailed in this destructive manner. It will be found on enquiry that the disease displayed itself with the most dreadful effect in all situations similar to those I have mentioned, uniformly breaking out on the banks of rivers, and being most destructive to those who dwelt on their banks, or inhabited low, damp, and filthy houses. This has been observed to be the fact in all its progress, both in traversing Asia and advancing through Europe. Mr Bell says, "it is a well-known peculiarity of the disease, that it is apt to attach itself to low-lying places, such as the banks of rivers usually are."* Mr Kennedy states, that "in the end of March 1818, the disease became developed in Allahabad, and moving progressively through this town, it destroyed 10,000 of the people in the lapse of a few months. On the western bank of the Jumna, and among many of the towns in the Doab, its progress could be distinctly traced from place to place."† Allahabad stands on a three-cornered spot of ground, where the rivers Ganga and Jumna join. "*Keeping close to the banks*, the pestilence ascended the Ganges, and entered Cawnpore the 8th of April."‡ It soon

* Bell, p. 85.

† Kennedy, p. 35.

‡ Page 36.

afterwards reached Benares, where it was most destructive. The population of this city is about half a million. It stands on a bank sloping down to the river. The houses are piled upon each other in successive stories. So narrow and so winding are the streets, that no wheeled carriage can pass through them, and they are crowded in every part. "Sacred bulls, as tame and familiar as dogs, walk lazily up and down, or lie about on the streets; and sacred monkeys are clinging to every roof, projection, and ornament." Both sides of the street are lined with beggars, covered with chalk and cow dung, and many of them preserving particular attitudes, by way of penance. "Hundreds and thousands of these idle, dirty, and useless people resort to Benares, and all this crowding of cattle and of men, and all this filth and want of ventilation, is beneath an Indian sun." The city of Kotta, which is also seated on the banks of a river, and of which the channel is deep and narrow, suffered severely, although built upon solid rock. In proceeding through Georgia, it attacked Tiflis in the most destructive manner. The heat of this city in the summer is described as intolerable, the thermometer being occasionally as high as 118 degrees of Fahrenheit in the shade. It is situated between a muddy river and a high mountain, amidst parched fields and barren hills;—the streets are very narrow—the houses have no glazed windows—the public markets, the baths, the river, and, indeed, the whole town, are, in the utmost degree, dirty and offensive.

In Europe, the disease in like manner invariably

developed itself in similar situations. Drs Russel and Barry state, with reference to St Petersburg, “that from the manner in which the disease has now broken out in this city, we see no other mode of accounting for its sudden appearance here, than by concluding that the *barks from places on the Wolga*, where the disease prevails, have brought *something* with them, which, disseminated in this atmosphere, has been the immediate cause of the eruption of Cholera which has just occurred.”* So Dr Becker states, “that in seaports, and towns situated on navigable rivers, in which the Cholera has appeared, it has been, as far as my knowledge goes, almost uniformly observed that the *first cases* of this disease have occurred in *boats*, and in houses situated in the *neighbourhood of the water*.”† Again he says, “the original seat of Cholera generally is the *river side*,”—that it “leaps” to other parts of a town, and shows itself “in narrow populous streets, in close, airless, dark, and crowded habitations, among a poor, ill-fed, ill-clothed population.”‡ At Berlin it broke out in a boat on the Frienow canal, and “various other cases now occurred in the boats and in the streets, in the immediate neighbourhood of the navigable part of the river, inhabited by persons who had intercourse with the shipping.”§ The inference which he deduces from this is, that the disease is caused by contagion. But the same phenomenon has occurred in Haddington and Musselburgh, which are situated on

* Papers, p. 26.

† Becker, p. 6.

‡ P. 7.

§ P. 8.

streams not navigable. Mr Bell says, "The recent outbreak of the disease at Haddington is a remarkable instance of its arising spontaneously. The first case in that town occurred on the 17th December, 1831. The man attacked resided in a filthy *close by the river side* ; and no contact or communication with any person coming from Newcastle or Sunderland, or from any other suspected quarter, could be traced." "This case was immediately followed by several others from the *same locality*, all on the *immediate margin of the river*."*

The disease has accordingly uniformly displayed itself, in the first place, among those who reside on the banks of rivers, or whose occupations lead them to resort to the neighbourhood of waters, while there is scarcely a single specific instance mentioned of its breaking out among classes who are placed at a distance from them, and in dry elevated positions. Thus, every author enumerates among those who are first attacked, fishermen, boatmen, sailors, skippers, workers in dockyards, washerwomen, and persons bathing in the rivers. It has also been seen, that in low, damp situations, every one without distinction is attacked. These peculiarities have been attempted to be explained, by stating, that persons of the above description are more exposed to cold, and therefore, it is inferred, are more susceptible to Cholera than others. But this is no satisfactory answer, because they are under a similar exposure both before

* Becker, p. 129.

and immediately after the disappearance of the disease, and yet they cease to be attacked. It seems scarcely possible to give any other explanation than that which has been suggested—that the animal poison being peculiarly attached to water, or frequenting the vicinity of it, they are more liable than the rest of the community to receive the poison, either through the medium of the water itself, or of food on which the insect may have deposited its eggs or larvæ.

Another circumstance confirmatory of this observation is, that armies have suffered most severely when encamped on the banks of rivers, or crossing them in the course of their marches. A very remarkable instance of this occurred in the army of the Marquis of Hastings, and which can be satisfactorily explained on the hypothesis which I have ventured to suggest. The army, consisting of 10,000 fighting men and 80,000 camp followers, was encamped on the banks of the Sinde. Soon after arriving on the ground, Cholera was observed among the lowest classes of the camp followers. It soon spread through the whole army, and, “contrary to the usual disposition of the malady, equally attacked the males and the females, the young and the old, the weak and the robust.*” The devastation was so dreadful, that no less than 5000 perished within five days. It was resolved to change the ground, “in order to save the army,” and a retreat was made towards *the south-east*, and a new position taken on the banks of

* Kennedy, p. 27.

the river Betwah. The *sick were carried along with the rest of the army* ; and on their arrival at this new encampment, many of them were restored to health, and the disease entirely left the army. This apparently strange circumstance is explainable only on the supposition—1st, That there was some poisonous agent in the river Sinde, and that the water being made use of by the army indiscriminately, spread in the simultaneous and undistinguishing manner which has been described ; and, 2d, That by the retreat to the *south-east*, while the pestilential agent was advancing to the *north-west*, a position was obtained in the rear of this devastating agent. It is impossible to explain the phenomenon on the theory of contagion, while it is quite consistent with the suggestion which I have made.

The same extraordinary, sudden, and simultaneous developement of the disease in the detachment which took up its position on the banks of a small inland lake, already alluded to,* can also be explained only on the same hypothesis. Again, in the report from Deccan by Mr Bucke, it is mentioned that “the Cholera appeared the 18th of July in the camp of the Mysore Silledar Horse while encamped on the north *bank of the Godavery*. The sudden and great prostration of strength which the patients experienced, exceeded any thing that I could have imagined. It is not unusual for a Silledar to arrive at the ground of an encampment *in perfect health*, be attacked with the

* See p. 29.

disease, and in an hour become so weak as to be totally incapable of the least exertion, even that of sitting upright.”* In another report, it is mentioned that a battalion left Nagpore on the 6th of February, 1821, and were then “in a healthy state, and continued so, with the exception of trifling complaints, until they arrived, March 11, at Secunderabad. Here they were encamped in a *small recess, among slightly elevated hills near the Hoosum Saugur tank*. The families were in more open ground, *but it was low, and near the edge of the water*. They remained encamped, while the sick carriage and other necessities were fitting, to enable them to proceed on their route. During the whole of this period no case of Cholera occurred. The disease did not make its appearance before the 19th of March, when Thomas Hitchins was suddenly seized at night, “and died in the course of twelve hours after the period of attack.” Additional cases then occurred; and the battalion having proceeded on their march, the disease increased as they approach the *Kistnah river*. “During the 1st of April, the party crossed that river, and pitched their camp on a sloping ground of black soil, near the village Khatoon. The Cholera now began to spread rapidly and with malignity, creating alarm in every direction. The followers and the women were the first that suffered. It commenced among the latter *almost as soon as they had crossed the river*. The number of deaths that took place this day was considerable.”

* Kennedy, p. 118.

While we have thus seen that Cholera breaks out and prevails chiefly on banks of rivers, lakes, &c., we also find that it extends its ravages to the adjacent neighbourhood—a circumstance quite in accordance with the hypothesis of the cause being an aquatic and aerial insect. Although it follows one grand line of direction, it stretches itself in extended wings on both sides, and on the above hypothesis it will deposit its eggs, and its larvæ will be generated in wells, or in water wherever situated, will penetrate into the low filthy abodes of the poor, and carry devastation among them by coming into contact with their food. Indeed, in Hungary the people were so convinced that the waters had been poisoned, that they rose and put to death many medical men; whom they supposed guilty of the crime.

4. Another circumstance, which tends to confirm the idea that the disease may possibly be communicated in the way I have suggested, is the sort of food which has been observed to have been taken preceding an attack. The hypothesis which I have formed is, that the poisonous agent may be introduced into the stomach, either through the medium of liquids or food. In regard to liquids, it is obvious how the poison may enter the stomach; and as to food, it is not impossible that the animal may either be imbedded in it, or may deposit its eggs or larvæ; and therefore, if the food be taken, it may operate immediately as a deadly poison. An experiment made by Redi, men-

tioned by Shaw, tends to show how easily this may happen, if due precautions are not taken.* It was supposed at one time that putrified meat generated maggots; and in order to ascertain whether this was true, two pieces of meat, precisely in the same condition, were exposed in separate vessels to the air. The one was left entirely uncovered, while the other was covered by a thin piece of gauze. Both putrified within the same time; and while the one which was *uncovered* was swarming with maggots, the *other* was entirely free from them. If a person had therefore taken any portion of the former at the period when meat is generally thought to be most fit for eating, he must have received into his stomach the eggs from which these maggots were produced, and if of a poisonous nature, would have suffered the necessary consequences.

Now the food which has been observed to have been taken, previous to an attack of Cholera, consists either of cold liquids, bad meat, raw food of all kinds, cold rice, vegetables; while, on the other hand, water which has been boiled, meat properly cooked, and hot rice, have never produced such effects.†

* 6 Shaw's Zoology, p. 3.

† To prevent misapprehension, let it be observed, that I do not attribute the disease to these or any other articles of *food*. I conceive that it is by *means of them* that the poisonous agent is conveyed into the stomach; and therefore, they are not objectionable, *provided* precautions be adopted either to prevent that agent coming into contact with them, or to destroy its poisonous qualities. This, indeed, is a necessary consequence of the hypothesis.

In the Bengal Report, it is stated that “ the individuals complained *generally after eating*, of great pain of stomach, faintness, and a sense of sinking as if life were quitting them. A great scarcity of grain then existed in the city, and the sufferers were generally of the poorer class, and debilitated by the *want of nourishing food*.”* In another passage, it is mentioned “ that the drinking of large draughts of *good or bad water* frequently preceded an attack,” and it is mentioned “ that nothing was more common than to see a person attacked by the disease immediately on drinking a large quantity of *water* after a long walk, or exposure to the sun. But in the camp of the centre division, where the *water was foul and scarce*, and only procurable at considerable distances, the Sepoys and followers *drank greedily from every muddy puddle* on their march, and hundreds were affected in this manner. So in the Nagpore force, where the heat and thirst of the men were excessive, the most fatal cases were brought up from the *beds of the rivulets*, in which the Sepoys had dropped during the line of march.”† In regard to another extraordinary attack on board of a ship, it is stated that “ the whole of the persons seized were of sober, regular habits ; they had all drunk largely of *cold water* previously to being attacked.”‡ On the other hand, it is mentioned that “ the natives placed great faith in *boiled water* as a preventive, and one of

* Bengal Report, pp. 60.

† Ibid. pp. 163, 164.

‡ Ibid. p. 322.

the principal native gentlemen in the city ascribed the *singular healthiness* of his numerous household *during the whole period of the epidemic*, to his having taken the simple precaution of allowing *no water* to be drank by them until it had been *previously boiled*.” *

It is also said, that “the mischievous consequences of eating bad, raw, and indigestible food were equally remarkable.” † And Mr Bell states that “unwholesome food, unripe fruit, or indulgence to excess in fruit, or acescent vegetables,” ‡ are to be carefully avoided ; that “it is usual with the natives of India to ascribe an attack of Cholera to their having taken an early meal of *cold rice*,” § and he recommends that “the aliment should be of easy digestion, generous, and nutritive.” || Dr Becker mentions “the immoderate use of *obnoxious articles of food or drink* as a common precursor of an attack,” ¶ and while he somewhat sneers at the idea of any sort of diet producing Cholera, as being inconsistent with the theory of contagion, he states that some peculiar articles of food have incurred the odium of being the principal cause of Cholera. In so far I concur with him that the *food itself* is not the cause, but I conceive that it is the *medium* through which *the cause* is introduced into the human constitution. Among other prejudicial articles enumerated by the Indian

* Bengal Report, p. 324. † Ibid. p. 164. ‡ Bell, p. 133.

§ Ibid. p. 136. || Ibid. p. 137. ¶ Becker p. 4.

writers, are melons, raw grain, and, in general, every sort of food which has not been cooked.

Another circumstance which supports the idea of the cause being imputable to a poisonous agent received into the stomach, is mentioned by Dr Becker. "Four young physicians, not satisfied with the information derived from the senses of sight, touch, and smell, thought proper to ascertain the properties of the blood and contents of the intestines, by *tasting* these fluids. One of them died within three days thereafter, and another was attacked with a very anomalous succession of symptoms, including most of those observed in Cholera, and which terminated in a very severe fever of the typhoid form." He mentions also a French medical man, "who inoculated himself with the blood and intestinal contents of Cholera patients—two hours afterwards he fell sick and giddy, but recovered after copious perspiration."*

It may not be unworthy of notice, too, that many of the lower animals have been observed to suffer under attacks similar to Cholera ;—a circumstance which those who advocate the doctrine of contagion do not dispute, but ironically throw aside. It is, however, a material fact in support of the hypothesis of poison being introduced into the stomach by means of cold unboiled water, raw vegetables, fruits, &c. ; and it will be recollected, that the same effect was produced on the lower animals by the poison which affected so many people in Leith. In the

* Becker, pp. 13, 14.

Bengal report, it is stated that “ it was observed in many places that an unusual mortality occurred amongst black cattle, sheep, dogs, and other domestic animals. Thus, in the Backergunge district, cattle had the disorder, and were cured by opium, and the other remedies found most serviceable in the human species.” The effects upon others are thus enumerated :—“ In Delhi, dogs died rapidly, and more horses than usual were carried off by the dry gripes.”—“ At Sumbhulpore, an elephant had every symptom of Cholera, and was cured by brandy and laudanum.”* Mr Bell likewise states, that “ in India the lower animals, such as cattle, monkeys, and poultry, suffered from the disease. And, if newspaper reports are to be credited, a similar phenomenon has been observed in some of the European continental towns; and in Hamburgh, in particular, it is said that the *fish* also in the rivers were affected.”† If the latter statement be true, it will go far to establish that insects which frequent rivers, or there deposit their eggs and generate their larvæ, are the cause of the disease. It is no where said, so far as I have learned, that *sea fish* have been so attacked. Another gentleman mentions in his official report, that “ during my residence at Trincomalee, it was no unfrequent occurrence to have the stock in a poultry yard nearly destroyed in a few hours. My memory exhibits to me a goose or a duck, seized with spasms,—*the water which it had hastily drank* to allay its thirst, pouring out of its

* Bengal Report, pp. 114, 195. † Bell, p. 66.

bill, and a similar fluid squirting from the cloaca, which frequently happened in 15 or 20 minutes after the animal was first observed to be sick.”*

These facts are very irreconcilable with the idea of contagion, but quite consistent with the hypothesis which I have suggested.

5. There are various other peculiarities in this disease, of which also contagion can afford no satisfactory explanation.

In the first place, it breaks out simultaneously, in various and distant places at once, and with symptoms precisely similar, but varying in degree according to the intensity of the poison. In India “it displayed itself,” says Mr Bell, “in several places, many miles distant from each other, nearly about the same time.”† This is quite in accordance with the hypothesis of the introduction into the stomach of a poisonous agent, through the intervention of food, of which the occurrence at Leith, in 1828, affords an illustration, but very difficult to explain on the theory of contagion. So it frequently happens that one entire family will be destroyed, while the neighbours are free from the disease. How this is to be accounted for on the idea of contagion, is beyond my comprehension; but, on the supposition of the poisonous agent being either in the water which they drink, or in the food which they eat, the phenomenon may be explained. Again, it has

* MS. Reports.

† Bell, page 69.

been repeatedly remarked, that while the medical gentlemen attending the hospitals are seldom attacked, the assistants are frequently so. Nay, in many of the most crowded hospitals, the latter do not suffer in the least. But if the poisonous agent be in the hospital, and so come in contact with the liquids or food, it can easily be understood how the medical men, who seldom eat or drink there, escape, while the assistants, who reside, and consequently eat and drink in the hospital, perish. On the other hand, if the poisonous agent be not in the hospital, they also will escape. Since its arrival in Britain, I am not aware of a single medical attendant having died, although breathing the same air, and even inhaling the breath of the patients.

Another peculiarity in this disease, for which contagion affords little or no explanation, is, that it generally displays itself during sleep. Whether this has been remarked as a peculiarity in Europe as much as it has been in India, I have not been able to ascertain ; but, on attending to the operating effects of poisons, it may be explained. During sleep, the nervous system is in a state of less activity than during waking hours ; but, in proportion as that system is less able to resist the poisonous influence, so the chance will be increased of the effects being displayed. To say that *sleep* produces or predisposes to the disease, seems absurd ; but there is no absurdity in supposing, that if there be a poisonous agent in the stomach which operates on the nerves, it will come into action at the time when the nerves are least capable of resistance.

Another very remarkable phenomenon attending the disease is, that it arrives suddenly; goes on rapidly increasing; and then, without any apparent cause, deserts the particular locality, and appears in another quarter. There, it again goes through the same progress, and at last, in an equally unaccountable manner, disappears. How this can be reconciled with contagion, I have not been able to discover; but it is quite reconcilable with the supposition of an insect being the cause.

We have seen that there are certain classes of insects which in their formed state live in the air, but deposit their eggs in waters. They thereupon perish, and consequently disappear. Their larvæ are generated in the water. When they arrive at maturity, and become winged animals, they proceed on their course, and, like their predecessors, again deposit their eggs in the waters, and perish. In this way flies will suddenly appear—then disappear—and, after the lapse of a short time, reappear. Now, in the Bengal Report it is stated, (but as a matter of so little importance that it is thrown into a foot note), that “in this city (Delhi) a curious thing was observed, that large swarms of flies, which had *infested the place before the breaking out of the epidemic, wholly disappeared during its prevalence, and returned as it withdrew.*” “This,” it is said, “might be owing to the cold sharp westerly wind then blowing,” but it is not said that this phenomenon was ever repeated when that wind blew.* It is, however, quite con-

* Bengal Report, p. 195.

sistent with the above phenomenon in the history of insects. Previous to the disease they appear in their aerial character ; deposit their eggs, and then perish. On my hypothesis, the disease should then break out, and continue till the larvæ arrive at the insect state, when they will leave the waters, proceed on their natural line of direction, and so the disease will disappear at that place, and soon afterwards break out in another. And this we find to be the fact. The same circumstance has been mentioned in the foreign journals, and I have been informed (but I do not know the truth of the fact), that immediately before the appearance of the disease in Haddington and Musselburgh, the arrival of large quantities of insects was observed. A fly also of a very peculiar and unknown nature has been observed in Edinburgh—even at a time when the weather was intensely cold. Indeed, in the course of writing these pages, a gentleman, for many years in India, has shown me a fly which he had frequently seen there, but never formerly in this country. It is of a very small size, black body, and light grey wings.

The night air has also been said to be prejudicial :—Of this fact, in Europe, there seems to be no evidence ; and as to India, I can easily imagine, that in a country where people frequently sleep in the open air, or with open windows, the poisonous agent may be unconsciously, and during sleep, inhaled. Nay, it is stated by Kirby and Spence, that there is in the West Indies a fly, which is regarded with a superstitious dread, because it frequents death-beds, and is seen to enter the mouth of the patient while asleep.

It is supposed that they there deposit their eggs. The reason why this is observed in patients obviously is, that *they* are attended and watched, while persons in health are not so. I do not pretend to say that this occurs in regard to Cholera ; but on the hypothesis of the existence of a poisonous insect, it is at least not impossible, but, on the contrary, probable, that those who sleep either in the fields, or with open windows, may thus be exposed to its attack.

It has been supposed that the dissipated are more peculiarly liable to the attacks of this disease than others, and perhaps it might be desirable to enforce this idea ; but it is one which does not appear to be consistent with truth, for we find that the weak, the robust, the young, and the old, are all equally exposed to its attacks. There can be no doubt, that if *they* receive the poison, it is much more likely to produce fatal results, than on one of a different habit of body ; and the explanation is in consistence with the hypothesis. The proximate cause of the disease is, an affection of, or injury to, the nervous system. In proportion, therefore, as that system is weakened, so the probabilities are that the patient will perish ; and, on the other hand, in proportion to the strength of the nervous system, the chances are that he will be saved. But nothing tends more to destroy the nervous system, than habits of dissipation ; and accordingly it is found that it is scarcely possible to save patients addicted to the most debilitating of all practices—that of dram-drinking.

We have thus seen that a class of poisons affect the nervous system, while they inflict comparatively little injury on the organ with which they come in direct contact—that animal poisons are of this class—that in Cholera the nervous system is injured by some hitherto unknown cause—and that the introduction of an animal poison into the stomach produces almost identically the same effects as those produced by Cholera. We have also seen that the phenomena of Entomology accord with the leading characters displayed by the concealed agent which generates this disease. The question, therefore, is not, Whether I have proved the hypothesis which I have suggested to be *true*; but whether the facts do not coincide more with that hypothesis, than with those which ascribe it to contagion, or to atmospheric and terrestrial influences? If there be a greater degree (however small that degree may be), for the probability of its truth, it is incumbent on us to act on the assumption of its truth, at least to the effect of adopting these preventives which it suggests; and happily these are greatly in accordance with the precautions which have hitherto been found most beneficial—a circumstance of itself affording evidence in support of its truth. Of course, I do not include in these the systems of cordons sanitaires, quarantines, &c., all of which have been found perfectly useless; and, indeed, on the supposition of the truth of my hypothesis, they are absurd. Their unavailing effects also afford testimony in favour of the high probability that the hypothesis is founded on truth.

In our present state of ignorance as to the nature of the poisonous agent, it is impossible to predicate what may be the most certain preventives. But the first and leading practical suggestion which I venture to offer, is one which is supported by experience, and is extremely simple. It is, that great care should be taken in regard to the use of water. Let it always be recollected, that it is not *the water* which is the cause, but that the water is the *medium* through which the unknown cause may be introduced into the stomach. It is important, therefore, that while the disease prevails, water should always be boiled, and after being so, that it be effectually protected from the air. As a farther precaution, it may also be filtered.*

* It is not impossible that Edinburgh may owe its hitherto extraordinary exemption from the disease, while it is raging at her gates, to the circumstance, that the Crawley spring, from which the town is supplied with water, is enclosed within a covered building—that the water is filtered through a bed of sand, and conveyed to the houses by pipes, and that the river Leith is so filthy that it is scarcely ever made use of. At the same time, as many of the poorer classes carry their water in open pitchers, or “stoups,” from the public wells, and it is allowed to stand in their abodes uncovered, I have no doubt that cases of Cholera will not unfrequently occur among them.

Much has been said as to the beneficial effects of cordons of police-officers established on the roads leading to Haddington and Musselburgh, where the disease prevails, in preventing contagion, by compelling vagrants to return to the infected quarter. Of the humanity of this I need say nothing; but it certainly appears to carry with it some degree of inconsistency. The assumption is, that contagion is the cause of the spreading of the disease, and that it is

The second practical result is, that no food should be eaten which is not cooked, and hot ; or, if cold, that it should be guarded from the possibility of being approached by any insect. Indeed, whatever is to enter the stomach ought, so long as the disease prevails, to be effectually covered up. In reference to this, it may be suggested, that while soup kitchens ought to be encouraged and supported, their beneficial effects may be defeated, if the poor are not warned to protect the food in the manner above-mentioned.*

The third and last suggestion is, that residences on the banks of rivers, and in low, damp situations,

transmitted by one person coming into contact with another. But police-officers are human beings, equally susceptible of contagion as any one else ; and although they must necessarily have daily communication or contact with the vagrants, yet the officers are allowed to return to their families in the city. Besides, an unlimited intercourse between Edinburgh and the adjacent districts has taken place among all the other members of the community ; and although the disease began in Haddington on the 17th December, 1831, and in Musselburgh soon thereafter, distant only about five miles, there have not been above twenty cases in Edinburgh up to the 20th of February, 1832. Indeed, the greater number of these should be classed among those of Haddington and Musselburgh, to which place they have been traced.

* It would be desirable, in reference to an enquiry into the cause of the disease, to ascertain how many of those supplied with food from the kitchens are attacked with the disease, compared with those who are not so—keeping in view the possibility of the former making use of other food or liquids. It would also be of importance to know, whether any instances occur of persons having contact with Cholera patients, but who have neither ate nor drank within the infected quarter, have been attacked.

should be avoided, and every exertion made to preserve the most perfect cleanliness.

In conclusion, I may venture to suggest, that future enquiries should not be left exclusively to medical men. That their assistance is indispensable, is beyond all doubt; but I humbly conceive, that unless they combine with their professional knowledge more severe, and correct habits of reasoning and induction than they have sometimes exhibited, our information will continue to be defective and unsatisfactory.

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